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Dear Sir:

The investigations toward spacecraft antenna problems have continued in two areas: (1) the admittance of radiating slots in the presence of lossy media, and (2) studies on the electrodynamics of moving media. A new area of investigation has been initiated: the development of geometrical techniques for the theoretical treatment of diffraction problems of aperture antennas. The following reports and papers will be published:

Du, L. and Tai, C. T., "Radiation Patterns of Four Symmetrically Located Sources on a Perfectly Conducting Sphere," 1691-10, 15 December 1964, Antenna Laboratory, The Ohio State University Research Foundation; prepared under Grant No. NsG-448 with National Aeronautics and Space Administration.

Compton, R. T., Jr., and Tai, C. T., "Radiation from Harmonic Sources in a Uniformly Moving Medium," to be published in the IEEE Transactions on Antennas and Propagation, May 1965.

Regarding the admittance of slots radiating into lossy media, theoretical techniques are to be developed for small aperture antennas in inhomogeneous, lossy media. Research is being done to determine a suitable numerical method, based on variational techniques, for admittance calculation of TEM parallel-plate guides and rectangular waveguides radiating into a medium having a complex index of refraction which varies only in the coordinate normal to the aperture.

The current problem being studied in electrodynamics of moving media is that of a dipole located above a moving medium. Insofar as possible the techniques which Sommerfeld used in his classical problem of a dipole above a flat earth (stationary medium) will be applied.

In other areas geometrical optics techniques applied to diffraction have been successful in the calculation of the radiation patterns of waveguide apertures (parallel-plate and rectangular) and horn antennas. Under this phase of the program geometrical optics techniques for the calculation of impedance of aperture antennas and the mutual coupling between aperture antennas are being developed. In these techniques the flow of diffracted energy can be described in terms of ray theory. Consequently, techniques of this type have several advantages over other techniques; generally other techniques utilize integration of aperture distributions. Principal advantages are that a wide variety of structural shapes may be treated and that a complete description of the distribution of energy is given (allowing back-lobes to be calculated and methods for computing impedance and coupling to be developed).

A geometrical method for calculating the TEM and TE_{01} mode impedances of parallel-plate waveguides radiating into free space is being completed. Numerical results obtained by this method will be checked by an independent method. Further developments are being made to establish geometrical methods for the calculation of impedance and coupling between rectangular waveguides. These developments may lead to alternate methods for calculating admittance of slots radiating into lossy media and to theoretical techniques for the study of large arrays of slots.

Sincerely yours,

Roger C. Rudduck

Roger C. Rudduck
Associate Supervisor

RCR:bk